

REVIEW OF THE NEOTROPICAL LEAFHOPPER GENUS
CHLOROGONALIA (HEMIPTERA: CICADELLIDAE: CICADELLINAE),
WITH NOTES ON THE GENUS *CALDWELLIOLA*

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Abstract.—*Chlorogonalia* Young, 1977, and *Caldwelliola* Young, 1977, are superficially very similar genera that may not be closely related genera within the tribe Cicadellini (Hemiptera: Cicadellidae: Cicadellinae). Two species, *Chlorogonalia ultima* Young and *Caldwelliola reservata* (Fowler), are particularly similar phenotypically and are sympatric in Ecuador (new country record for *C. reservata*). New diagnostic features are given for both genera; two of these features can be assessed in undissected specimens. *Caldwelliola tharma* (Young) is proposed as a **new combination** (from *Chlorogonalia*). Species of both genera are possible vectors of the bacterium *Xylella fastidiosa* in coffee; *Caldwelliola caucana* has been directly implicated as a vector of the crespersa disease in Colombia. An illustrated key is included to distinguish the four known species of *Chlorogonalia*.

Key Words: Cicadellidae, *Xylella fastidiosa*, vector, crespersa, coffee

There are 328 genera and over 2,200 species of sharpshooters (Hemiptera: Cicadellidae: Cicadellinae) in the New World (Leafhoppers of the World Database; McKamey, in preparation). The group is unusual in the Cicadellidae for feeding on the host plant's xylem rather than phloem or parenchyma. The xylem is deficient in nutrients and is therefore imbibed and excreted in large amounts, the latter activity giving these insects the common name of sharpshooters. Some members of this group are also well known for vectoring the bacterium *Xylella fastidiosa*. For example, species of the genus *Homalodisca* Stål vector *X. fastidiosa* in grape in the United States, causing Pierce's Disease, and genera such as *Acrogonia* Stål vector it in citrus in

Brazil, causing citrus variegated chlorosis. Most New World sharpshooters were included in two revisions by Young (1968, 1977), the earlier revision covering the tribe Proconiini and the more recent dealing with Cicadellini. Two of the 163 New World genera of Cicadellini, *Chlorogonalia* and *Caldwelliola*, are extremely similar in both external and internal features but may not even be closely related, their similarities being superficial. In the process of identifying a putative pest species, it was discovered that some specimens (USNM) of *Caldwelliola* had been misidentified by Young as *Chlorogonalia*, indicating that a clearer diagnosis of the two genera was needed. No host records have been reported in the literature for either, but both genera

contain species commonly associated with coffee, which suffers from a *Xylella fastidiosa*-induced disease.

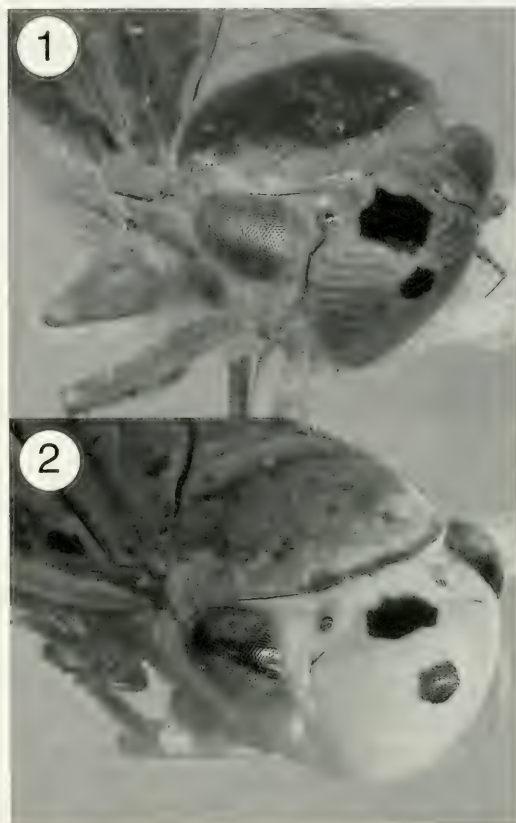
REVIEW OF LITERATURE

Among the many new leafhopper genera described by Young (1977) were *Chlorogonalia* and *Caldwellioli*, both replete with newly described species. Young considered the closest relatives of *Chlorogonalia* to be *Cicadella* Latreille and *Draeculacephala* Spinola, whereas he suggested that *Borogonalia* Young is the closest relative to *Caldwellioli*.

Young (1977) distinguished *Chlorogonalia* from *Caldwellioli* based on the aedeagal paraphyses, the former having their two arms (paraphyses) symmetrical in form but asymmetrical in position, and the latter having the paraphyses asymmetrical in form and position. Another feature was the rudimentary abdominal apodemes in *Chlorogonalia*, compared to strongly developed apodemes in *Caldwellioli*. Neither feature can be assessed without dissection.

Nevertheless, Young used some undissected specimens to report species distributions, leading to incomplete country records for *Caldwellioli*. In particular, Young misidentified some Ecuadorian specimens (USNM) of *Caldwellioli reservata* (Fowler), **new country record**, as *Chlorogonalia ultima* Young. *Caldwellioli reservata* had been reported to occur only in Central America.

The most obvious feature of both species is a pair of marks on the head, one dorsally and one anteriorly (Figs. 1–2), which vary intraspecifically in size and shape. Unfortunately these are not diagnostic, being found in other cicadelline genera and species—e.g., *Macunolla ventralis* (Signoret), which, like most species of *Chlorogonalia* and *Caldwellioli*, has green wings. Young's confusion of the two species is understandable given that *Chlorogonalia ultima* (Figs. 3–4) resembles populations of *Caldwellioli reservata*

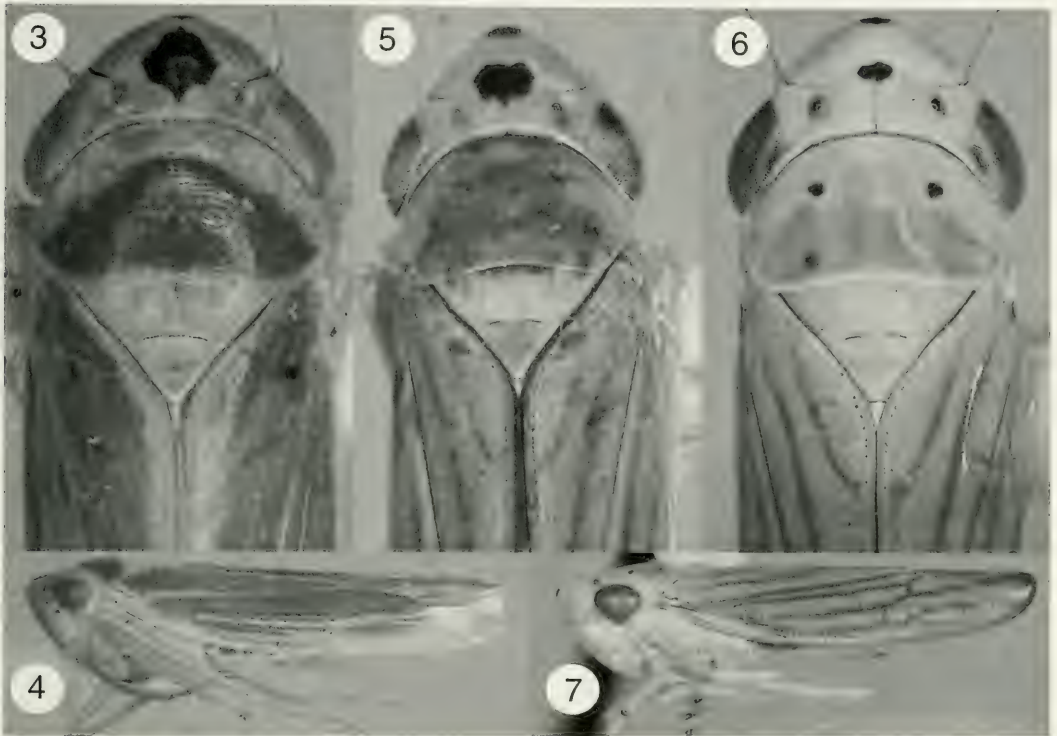


Figs. 1–2. Oblique aspect of anterior portion. 1, *Chlorogonalia ultima*. 2, *Caldwellioli reservata*.

in Ecuador (Fig. 5), lacking the pronotal markings found in the Central American populations (Figs. 6–7). Neither *Chlorogonalia* nor *Caldwellioli* have received further taxonomic attention.

MATERIALS AND METHODS

The pygofer and genitalia were prepared by placing the abdomen, separated from the body at its base, in a weak solution of potassium hydroxide (KOH) overnight. KOH-treated parts were preserved in glycerin in polypropylene microvials beneath the specimens. Digital images were captured at 400 dpi resolution using a Sony DKC5000® digital camera mounted on a Leica MZ-APO™ stereoscopic microscope.



Figs. 3-7. 3-4, Ecuadorian *Chlorogonalia ultima*. 5, Ecuadorian *Caldwellioli reservata*. 6-7, Central American populations of *C. reservata* have additional macula on the pronotum that distinguish them more easily from *C. ultima*.

Specimens examined are deposited in the National Museum of Natural History, Smithsonian Institution (USNM).

Literature citations designated with key letters are consistent with the bibliography by Metcalf (1964).

RESULTS

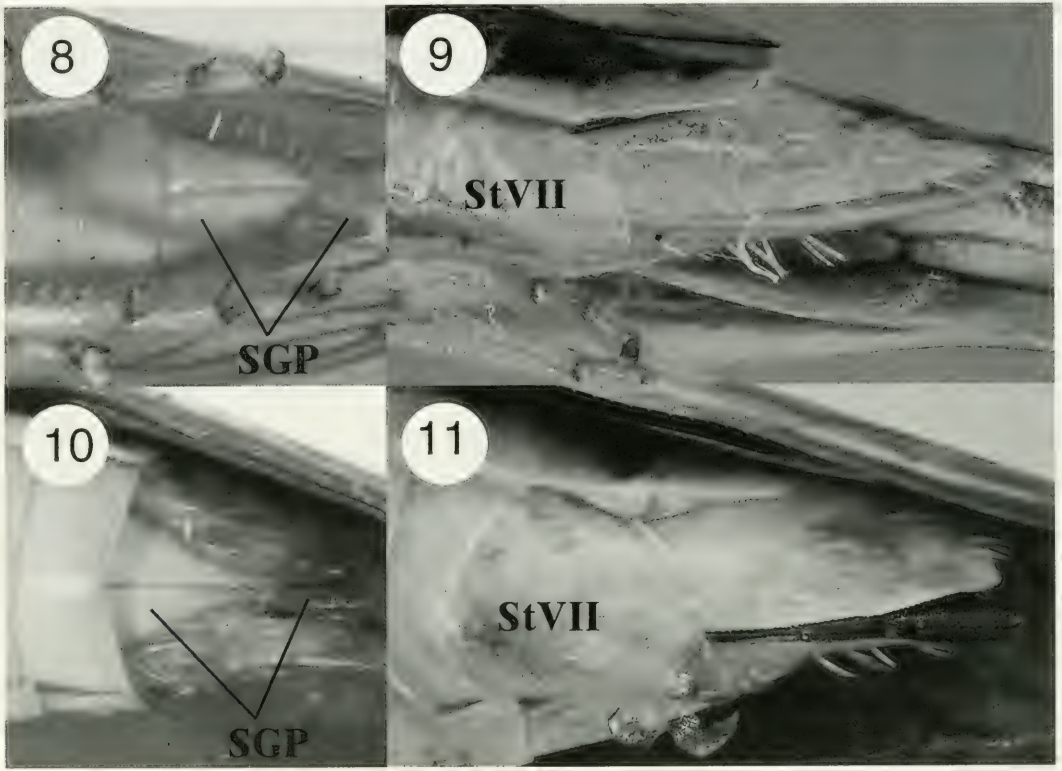
Chlorogonalia Young

Type species: *Tettigonia coeruleovittata* Signoret 1855, by original designation.

Diagnosis.—The genus *Chlorogonalia* differs from other New World Cicadellini in having the following combination of characters: head vertex with small lenticular impressions between the ocelli; forewing lacking numerous crossveins distally (Fig. 4); abdominal segment XI rudimentary (less than or equal to 0.2× length of entire pygofer); male with

subgenital plates triangular except abruptly narrowed in distal 1/5 (Fig. 8); paired, symmetrical aedeagal paraphyses located at its base; male genital style with apex acute; and female with abdominal sternum VII acute to weakly emarginate and approximately 1/3 length of exposed pygofer in ventral view (Fig. 9).

Discussion.—Species of *Chlorogonalia* usually can be recognized by their green body and forewings, except for hyaline forewing apical cells (Figs. 2, 4), and a pair of apical marks on the head (Figs. 3, 12-13), which in some individuals are confluent but constricted at mid point. As noted above, however, the species *Caldwellioli reservata* (Fig. 5) may be confused with *Chlorogonalia ultima* (Fig. 3). The features Young (1977) used to distinguish *Chlorogonalia* from *Caldwellioli*, namely the asymmet-



Figs. 8–11. External features distinguishing *Chlorogonalia* species (8, 9) from *Caldwellioli* species (10, 11) in males (8, 10) and females (9, 11). *SGP*, subgenital plate; *StVII*, abdominal sternum VII.

rical aedeagal paraphyses and enlarged abdominal sternum II apodemes (Figs. 15, 17) in the latter, are not consistent. The paired paraphyses in *Caldwellioli* are sometimes symmetrical and also often flattened, the combination not found in *Chlorogonalia*. The sternum II apodemes in some *Caldwellioli* individuals (e.g., *C. cunahua* Young holotype) are sometimes diminutive. Four consistent features were found that distinguish the genera: the form of the subgenital plates (Fig. 8), the apical form of the styles (Fig. 17), the relative length of abdominal segment XI in the male (Figs. 18–19), and the relative size of abdominal sternum VII in the female (Figs. 9, 11). The differences in the relative length of abdominal segment XI, most notable in the male (Fig. 18)

but also present in the female (Fig. 19), and in the length of sternum VII relative to the exposed pygofer (Figs. 9, 11) were neither mentioned nor illustrated by Young (1977). As a result of this redefinition of the genus and examination of the holotype (USNM), one **new combination** is proposed: *Caldwellioli tharma* (Young) (from *Chlorogonalia*; Figs. 14–15). The genera can now be distinguished from undissected specimens by examining the form of the subgenital plates in the male (Figs. 8, 10) and sternum VII in the female (Figs. 9, 11).

KEY TO SPECIES OF *CHLOROGONALIA*

1. Forewing subhyaline with brown veins *delongi* Young
- Forewing mostly green, with green veins except apical cells hyaline (Fig. 4) 2

2. Head vertex with black mark with length more than $2\times$ its median width (Fig. 12). *losoplanensis* (Schröder)
- Head vertex with black mark with length equal to or less than its median width 3
3. Pronotum and forewing sometimes marked with blue (Fig. 13); aedeagus in lateral view convex at mid length (Young 1977: Fig. 467p) *coeruleovittata* (Signoret)
- Pronotum and forewing not marked with blue; aedeagus in lateral view gradually narrowing to apex, not convex at mid length (Young 1977: Fig. 472p) *ultima* Young

SPECIES OF *CHLOROGONALIA**C. coeruleovittata* (Signoret 1855)

Tettigonia lineata Signoret 1854a: 21 [n.sp., preoccupied].

Tettigonia coeruleovittata Signoret 1855d: 813 [nom. nov. for *T. lineata* Signoret].

Tettigonia coeruleovittata delineata Fowler 1900c: 277 [n. subsp.].

Chlorogonalia coeruleovittata: Young 1977: 575, Fig. 469 [n.comb.].

Notes.—*Chlorogonalia coeruleovittata* is a widespread species, known from southern Mexico, Guatemala, El Salvador, Costa Rica, Venezuela, Colombia, and Brazil (Young 1977 and USNM specimens). It recently was found to be common in a coffee plantation in southern Mexico (McKamey, unpublished). Although the coffee was not suffering from crespers disease (see below for characteristics), it is likely that the species also feeds on coffee elsewhere in its range, including other coffee-producing areas, and might be involved in the spread of crespers (see notes for *Caldwelliella* below). Usually having distinctive blue marks on the pronotum and wings (Fig. 13), *C. coeruleovittata* is the most easily identified species in the genus. Male individuals without the blue markings can be identified based on the aedeagal structure (Young 1977, fig. 469).

C. delongi Young

Chlorogonalia delongi Young 1977: 575, Fig. 473 [n.sp.].

Notes.—*Chlorogonalia delongi* differs from other *Chlorogonalia* in having nearly translucent forewings, in contrast to the green forewing basal and discal cells of other species, and an angulate head with the central dorsal macula distinctly longer than wide. The species is known only from Mexico (Cuernavaca, Distrito Federal, Michoacán, and Puebla) (Young 1977).

C. losoplanensis (Schröder)

Tettigella losoplanensis Schröder 1959: 67 [n.sp.].

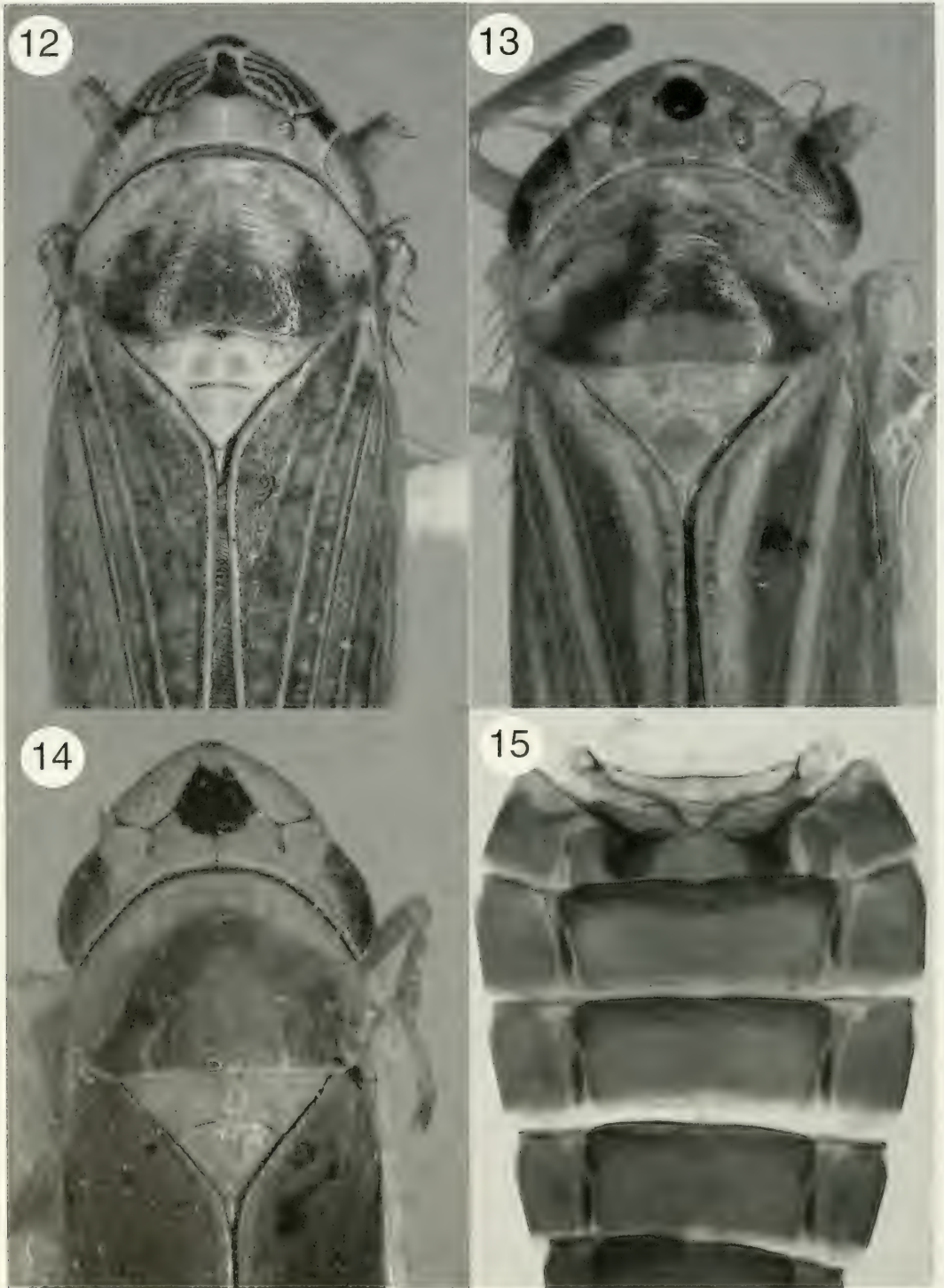
Chlorogonalia losoplanensis: Young 1977: 575, Fig. 470 [n.comb.].

Notes.—This uncommon species (10 specimens known) is recorded from Mexico and Panama. The two medial macula (Fig. 12) on the head are sometimes confluent.

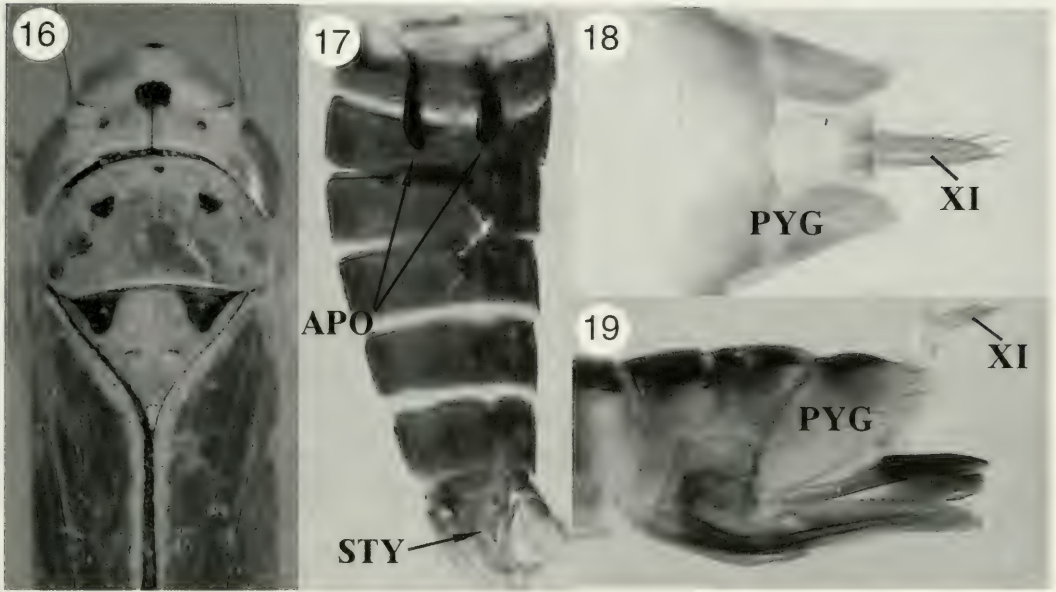
C. ultima Young

Chlorogonalia ultima Young 1977: 577, Fig. 472 [n.sp.].

Notes.—*Chlorogonalia ultima* (Figs. 1, 3–4) is recorded only from South America (Colombia, Ecuador, and Peru), where it is common (USNM specimens, including holotype). Young (1977) went so far as to say that “small green or yellowish Neotropical Cicadellini are likely to belong in *Scopogonalia*, *Caldwelliella*, new genus, or in *Chlorogonalia ultima*, n. sp.” It closely resembles Ecuadorian populations of *Caldwelliella reservata* (Figs. 2, 5), which had been misidentified by Young as *C. ultima*, but differs in the four diagnostic features mentioned earlier. They are sympatric in Ecuador in the most narrow sense of the word: in two instances *Chlorogonalia ultima* and *Caldwelliella reservata* have been collected in the same collection lot—in “Victoria/Aranillas,” 150 m, 18–19 Aug 1977, Luis E. Peña, El Toro Province (USNM), and “Los Rios” [city and province], 2 March 1938, Wm. Cl-



Figs. 12-15. Features of *Chlorogonalia* and *Caldwellioli*. 12, *Chlorogonalia losoplanensis*. 13, *C. coeruleovittata*. 14-15, Dorsal habitus and anterior portion of cleared abdomen of *Caldwellioli tharma*.



Figs. 16–19. Features of *Caldwellioli*. 16, Dorsal habitus of *C. caucana*, an implicated vector of coffee crespersa disease in Colombia. 17, *C. reservata*, cleared male abdomen, showing the large sternum II apodemes (*APO*) often, but not always present in *Caldwellioli*, and the blunt genital style (*STY*). 18–19, Dorsal and lateral aspects of large abdominal segment XI. 18, *C. caucana*, male. 19, *C. reservata*, female.

Macintyre (USNM). This is a new country record for *C. reservata*.

Caldwellioli Young

Type species: *Tettigonia reservata* Fowler 1900, by original designation.

Species of the genus *Caldwellioli* resemble *Chlorogonalia* or *Crossogonalia* Young but may be recognized by the features given by Young (1977) in addition to the new features noted above that distinguish it from *Chlorogonalia*. With regard to the lengthened abdominal segment XI in *Caldwellioli*, in males the range is 0.3–0.7× the length of the entire pygofer (Fig. 18). This feature is widespread in Cicadellinae but serves to distinguish it from *Chlorogonalia* and was the basis for referring *C. tharma*, to *Caldwellioli*, new combination, as mentioned above. The nine described species of the genus are Neotropical, recorded from Mexico and much of Central and

South America. *Caldwellioli reservata* previously was known only from Central America, where populations have black marks on the pronotum and scutellum (Fig. 6–7) similar to those of *C. caucana* Young in Colombia (Fig. 16).

In a study of Cicadellidae as possible vectors of the “crespersa” disease, the Centro Nacional de Investigación de Café (CENICAFE, Chinchina, Caldas, Colombia) sent specimens of six abundant species to the Systematic Entomology Laboratory, U.S. Department of Agriculture, for identification. In Costa Rica, Rodríguez et al. (2001) have indicated that the causal agent for crespersa is the bacterium *Xylella fastidiosa* (also responsible for citrus chlorosis in Brazil and Pierce’s Disease of grape and peach in the United States), and it is vectored by two sharpshooter leafhoppers. Among the CENICAFE specimens were three sharpshooters capable of transmitting *X. fastidiosa*: *Graphocephala* n.

sp., *Juliaca scalarum* Young, and *C. caucana*. Both species previously were recorded from Colombia but host plants were unknown. Young (1977) provided a diagnosis and illustration for *J. scalarum* (his Fig. 387) and *Caldwellioli caucana* (his Fig. 845; here an anterior, dorsal habitus, Fig. 16). The specimens were collected in Dept. Risaralda. *Juliaca scalarum* is known from Cundinamarca as well as Cochabamba, Peru. *Caldwellioli caucana* was known from Popayan and Valle, Colombia. The coffee crespera disease is characterized by proliferation of vegetative buds, which leads to an over-production of leaves and shortening of internode distance, thus producing dwarf trees with a "witches broom" appearance. In extreme cases, only vegetative tissue is produced, causing a total loss of productivity. *Chlorogonalia coeruleovittata* also feeds on coffee and thus has the potential to spread the disease.

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